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ARTICLE

School Food Environments and Policies in US Public Schools

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What's Known on This Subject

Recent national studies have described school food environments and policies, but they have not examined how these environments and policies vary by grade level or other school characteristics.

What This Study Adds

Using a national sample of public schools in 2005, we provide a summary score of healthy school food environments and policies and show how this score varies by grade level and other school chararacteristics.

ABSTRACT

OBJECTIVE. The purpose of this study was to describe school food environments and policies in US public schools and how they vary according to school characteristics.

METHODS. We analyzed cross-sectional data from the third School Nutrition and Dietary Assessment study by using a nationally representative sample of 395 US public schools in 129 school districts in 38 states. These 2005 data included school reports of foods and beverages offered in the National School Lunch Program and on-site observations, in a subsample of schools, of competitive foods and beverages (those sold in vending machines and a la carte and that are not part of the National School Lunch Program). Seventeen factors were used to characterize school lunches, competitive foods, and other food-related policies and practices. These factors were used to compute the food environment summary score (0 [least healthy] to 17 [most healthy]) of each school.

RESULTS. There were vending machines in 17%, 82%, and 97% of elementary, middle, and high schools, respectively, and a la carte items were sold in 71%, 92%, and 93% of schools, respectively. Among secondary schools with vending and a la carte sales, these sources were free of low-nutrient energy-dense foods or beverages in 15% and 21% of middle and high schools, respectively. The food environment summary score was significantly higher (healthier) in the lower grade levels. The summary score was not associated with the percentage of students that was certified for free or reduced-price lunches or the percentage of students that was a racial/ethnic minority.

CONCLUSIONS. As children move to higher grade levels, their school food environments become less healthy. The great majority of US secondary schools sell items a la carte in the cafeteria and through vending machines, and these 2 sources often contain low-nutrient, energy-dense foods and beverages, commonly referred to as junk food. *Pediatrics* 2008;122:e251–e259

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Key Words
schools, nutrition policy, diet, child, adolescent, vending machines, beverages, food

Abbreviations
USDA—US Department of Agriculture
SFEP—school food environment and policy
NSLP—National School Lunch Program
SNDA-III—third School Nutrition and Dietary Assessment study
SFA—School Food Authority
FRPL—free and reduced-price school lunch
CCD—common core data
SHPPS—School Health Policies and Programs Study
GAO—US General Accounting Office

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IMPROVING THE FOOD environments and policies in schools has been suggested as a population-based approach to improving children's diets and reducing their risk of obesity.[1,2] Students spend many of their waking hours at school, and a significant portion of their daily food intake is consumed there.[3] Evidence from experimental and observational studies indicates that the school food environments are related to students' dietary behavior[4–6] and body weight.[7]

The US Department of Agriculture (USDA) sets standards for the nutrient content of the meals provided through the National School Lunch Program (NSLP) and the School Breakfast Program. However, there are no federal regulations governing the nutrient content of competitive foods and beverages, items that are not part of reimbursable, USDA meals.[8] This includes foods and beverages that schools sell in the cafeteria as a la carte items (not part of the USDA meal) or that schools sell through fundraising events, snack bars, school stores, or vending machines.

Between 2003 and 2005, >200 pieces of legislation were introduced in US state legislatures to establish nutritional standards in schools or to address the availability or quality of competitive foods.[9] Federal legislation was passed in 2004 that required local education agencies to develop a "wellness policy" by 2006 that included nutrition guidelines

for all of the foods available in schools. More recently, there has been debate in the US Congress over enacting an amendment to the farm bill that would further restrict the sale of unhealthy foods and beverages in schools.[10] Despite the continued increases in the prevalence of childhood obesity[11,12] and the public response to this problem in the form of legislation focused on school foods, there are only limited recent data describing US school food environments and policies (SFEPs).[8,13–16]

US public schools differ widely in the socioeconomic status and racial/ethnic composition and of their student bodies.[17] This is a potential source of variation in SFEPs that is of particular interest in addressing the US obesity epidemic. Socioeconomic and racial/ethnic disparities have been documented in the prevalence of obesity in adults[12,18] and teens,[11,18,19] as well as in neighborhood food environments.[20,21] It is plausible that differences in SFEPs, if present, could contribute to disparities in the prevalence of obesity.

Using data collected in the spring of 2005 from a nationally representative sample of US public schools in the third School Nutrition and Dietary Assessment (SNDA-III),[22] we describe a range of SFEPs, including the sources and quality of competitive foods and the content of reimbursable, USDA school lunches. We also examined whether these environments and policies are associated with the racial/ethnic composition and household income of school's students.

METHODS

Study Design and Sample

SNDA-III was designed to assess the USDA school meals programs, along with other aspects of SFEPs. During the spring of 2005, survey data were collected in a nationally representative, cross-sectional sample of US public schools participating in the NSLP by using a multistage sampling approach. From the 7 USDA geographic regions, school districts were randomly sampled. Approximately 3 schools were randomly selected from each school district, including an elementary, middle, and high school.

Participation rates at the district and school levels were 83% and 95%, respectively. Districts and schools that declined to participate were replaced by substitutes that were randomly selected. The final study sample included 395 schools in 129 districts in 38 states. Questionnaires were administered to the School Food Authority (SFA) directors (directors of the school district nutrition programs), the school principals, and the school food service managers. The school food service managers also completed detailed data collection forms covering the lunch menu for a 5-day school week. These forms provided data on the types and quantities of food served to students as part of USDA-reimbursable school lunches. Finally, in a randomly selected subsample of schools, on-site observers used checklists to document foods and beverages that were available in vending machines ($n = 282$ schools) and served a la carte during school meals ($n = 287$ schools).

Data collection procedures for SNDA-III were approved by the Office of Management and Budget and the Council of Chief State School Officers' Education Advisory Committee. Data analyses for this article were approved by an independent institutional review board (Public/Private Ventures, Philadelphia, PA).

SFEPs

We characterized SFEPs by using data obtained from questionnaires administered to the school and district staff, as well as by using results from a nutrient analysis of school menu data. On the basis of the questionnaire and menu survey data, we derived 17 binary ("yes/no") variables that indicated the presence of a "healthy" school food policy or environmental characteristic. The variables were grouped into 3 domains: (1) policies or practices of the district or school; (2) availability of competitive foods; and (3) content of USDA school lunches offered (Table 1). Of the 8 variables describing policies and practices, 4 were obtained at the school level (from school principals or food service managers), and 3 were obtained at the district level (from SFA directors) and applied to all of the schools in that district. The presence of "pouring rights" contracts, which are contracts with a beverage company establishing it as the sole-source vendor for beverages in the school, was assessed in both the principal survey and the SFA director survey. Both data sources were used because each contained some missing data on pouring rights contracts. For 171 schools that had missing data on this item in the principal survey, we used data from the SFA director survey. For 76 schools, the data on contracts were available from both sources but were not in agreement, and these schools were classified as having a pouring rights contract if either source indicated that there was a contract.

Restrictions on the sale of competitive foods were considered for 3 possible sources: vending machines, fundraising activities by school organizations, and snack bars/school stores. We created 2 variables to classify students' access to vending machines: whether there were any machines on school grounds and whether the machines, if present, were located in the food service area. We also collected information on the hours during which vending machines were accessible to students. However, because more than one third of schools did not supply data on this variable, we did not include it in our analysis.

We used the data from the site visitors' checklists to assess the accuracy of the questionnaire data from principals on vending machines (presence and location) and to determine whether schools sold a la carte items in the cafeteria during lunch (data that were not available from the surveys). In only 4% of schools with data from both sources did the survey data not agree with on-site data: 4 schools in which the principal incorrectly reported no vending at all on campus and 8 schools in which the principal correctly reported vending but incorrectly reported that there was no vending in the food service area. Because checklist data were not available for the full sample, the principal responses were used in analysis.

The 5 variables used to categorize the USDA-reimbursable school lunch were derived on the basis of a nutrient analysis of the menu survey data. The percent-

TABLE 1 **SFEPs Assessed in SNDA-III**

Item No.	Environment and Policy Description	Survey Source
Policy or practice of district or school		
1	Has a wellness policy addressing student nutrition and physical activity	School principal
2	Has a nutrition or health advisory council	School principal
3	Information available on the nutrient content of USDA-reimbursable meals	School food service manager
4	Has nutrition education in every grade	School principal
5	No pouring rights contract	School principal and SFA director
6	No foods or beverages offered from brand-name or chain restaurants	SFA director
7	Uses DOD's Fresh Fruit and Vegetable Program or state's Farm to School program	SFA director
8	Has nutrient requirements as part of its food purchasing specifications	SFA director
Availability of competitive foods and beverages		
9	No store or snack bar selling foods or beverages	School principal
10	No fundraising activities selling sweet or salty snacks	School principal
11	No vending machines in the school	School principal
12	Has vending machines but not in food service area	School principal
Content of USDA lunches offered		
13	Whole and 2% milk not offered	School food service manager
14	Fresh fruit or raw vegetables offered daily	School food service manager
15	French fries not offered	School food service manager
16	Dessert not offered	School food service manager
17	Average meal has ≤30% of calories from fat	School food service manager

DOD indicates Department of Defense.

age of calories from fat in the average lunch offered was determined by analyzing data on the foods and portions offered during the menu survey period. The nutrient analysis was conducted by using the USDA Survey Net nutrient database.[23]

We used the checklist data to determine whether low-nutrient, energy-dense foods or beverages were available through vending and a la carte. We considered low-nutrient, energy-dense foods or beverages as those that are high in calories but have relatively small amounts of micronutrients. For beverages, sweetened carbonated soft drinks, hot chocolate, juice drinks (<100% juice), sweetened teas, and "energy" or "sports" drinks were all considered low-nutrient, energy-dense items. The categories of low-nutrient, energy-dense foods were as follows: chips (regular, not lower or reduced fat), cookies, ice cream, cake-type desserts, muffins, pastries, donuts, rice crispy treats, candy, energy bars, fried potatoes, and fruit roll-ups.

School Characteristics

In SNDA-III, schools were placed in 1 of 3 mutually exclusive categories on the basis of the grade levels taught in each school: elementary (lowest grade was ≤3 or the lowest grade was 4 or 5 and the highest was <8), middle (the lowest grade was 4 or 5 and the highest grade was ≥8 or the lowest grade was 6–9 and the highest was <10), and high school (the lowest grade was ≥10 or the lowest grade was 6–9 and the highest was ≥10). For select analyses, we examined the prevalence of SFEPs among middle and high schools combined and refer to these as "secondary schools."

Data on student enrollment, household income, and race and ethnicity were obtained from the National Center for Education Statistics common core data (CCD) for the 2004–2005 school year. Students whose household income is ≤185% of the federal poverty threshold are eligible to receive free and reduced-price school lunches (FRPL) in the NSLP. Our measure of the household income of each school's student population was the percentage of students certified to receive FRPL through applications or direct certifications. This was computed on the basis of CCD on student enrollment and the number of students certified for FRPL. Using CCD on the number of students in each racial/ethnic group, we calculated the percentage of students in a school belonging to a minority racial or ethnic group, here defined as any group that was not non-Hispanic white. The CCD was missing information on FRPL for 37 schools (9.4%) and on race and ethnicity for 16 schools (4.1%). These missing data were replaced with data either from the CCD in a previous school year or from information found on state Web sites that reported these data in 2005, as required by the US Department of Education No Child Left Behind Act of 2001.[24]

Finally, we characterized school geographic location. On the basis of data obtained from the US Census Bureau, the CCD classifies schools on the basis of their location in or near a city. We used 3 categories: in a city, in a suburb near a city, or not near a city.[25]

Statistical Analysis

To examine the question of whether SFEPs were associated with these and other school characteristics, we did not want to rely only on summarizing multiple comparisons between school characteristics and each of the 17 items used to describe SFEPs (Table 1). Therefore, we also created a summary score for these 17 items that provides a more complete view of school food environments. Because this type of summary score could conceal important relationships between school characteristics and the school food environment, we also present

TABLE 2 **Characteristics of Schools ($N = 395$) in SNDA-III**

Characteristic	n[a]	% (SE)[b]
School grade levels		
Elementary school	143	62.9 (2.2)
Middle school	126	18.3 (1.7)
High school	126	18.8 (2.0)
Student enrollment[c]		
Elementary and middle schools		
Small (<400 students)	44	30.9 (4.6)
Medium (401–600 students)	86	41.2 (4.0)
Large (>600 students)	139	27.9 (3.3)
High schools		
Small (<450 students)	14	33.5 (9.8)
Medium (451–1000 students)	31	33.4 (6.5)
Large (>1000 students)	81	33.1 (6.0)
Percentage of racial/ethnic minorities		
Low (≤10% of students are minorities)	123	32.3 (5.0)
Medium (>10%–45% of students are minorities)	109	34.2 (4.3)
High (>45% of students are minorities)	163	33.5 (3.8)
Household income		
High (≤30% of students certified for FRPL)	111	30.4 (3.9)
Medium (>30%–50% of students certified for FRPL)	132	30.7 (4.7)
Low (>50% of students certified for FRPL)	152	38.9 (3.8)
Proximity to a city		
In a city	151	31.1 (4.6)
Suburb of city	111	19.1 (3.5)
Not near a city	132	49.8 (5.3)

[a] n is the unweighted sample of schools.

[b] Percentages reflect the percentage of US public schools that participate in the NSLP.

[c] Student enrollment was higher in high schools than in elementary and middle schools; therefore, separate categories were determined for these 2 groups.

results for the individual prevalence of SFEPs by the percentage of school students who were racial or ethnic minorities or certified for FRPL.

To create the SFEP score, each of the 17 items was first coded as a binary (no = 0 and yes = 1). The score was computed as the sum of the "yes" items, giving possible scores ranging from 0 to 17, with higher scores indicating a healthier school food environment. In computing the SFEP score, we characterize access to vending machines by dividing schools into 3 mutually exclusive groups and scoring them in the following way: 2 (no vending machines on the school campus), 1 (vending machines present but not in the cafeteria), or 0 (all others). Our intention was not to assign vending a greater importance in the SFEP score but, rather, to allow variability in student vending exposure that could not be captured with a single binary variable.

We first described the prevalence of the 17 items used to characterize SFEPs. We used χ^2 tests to determine whether the prevalence of each school food environment or policy was different across categories of school characteristics. To facilitate interpretation of our analyses, we created categorical variables to describe the student enrollment, racial and ethnic composition of school students, and household income of school students (Table 2). The cut points for these categories were chosen to divide the schools approximately into tertiles. We used analysis of variance to compare the mean SFEP score across categories of school characteristics. Differences were determined to be statistically significant at a P value of $<.05$.

In our statistical analyses, we incorporated the features of the complex sampling design of the SNDA-III. All of the reported prevalences and means were adjusted for the school sample weight. All of the SEs were adjusted to account for sampling strata and the clustering of schools within districts. To incorporate the features of the sampling design, we conducted our statistical analysis by using SAS 9.1 (SAS Institute, Inc, Cary, NC), including its survey commands, and SUDAAN 9.0 (Research Triangle Institute, Research Triangle Park, NC). Finally, we applied the National Center for Health Statistics/USDA standards for statistical reliability to identify all of the instances where point estimates may be statistically unreliable because of small sample size or a large coefficient of variation.[26]

RESULTS

Sixty-three percent of the schools were elementary schools, and half of schools were in a city or suburb of a city (Table 2). The 3 most common policies or practices were not offering food from a brand-name restaurant (72%), offering nutrition education in every grade (68%), and providing nutrient content for school meals (60%; Table 3). However, less than half of the schools had a wellness policy, used a government fruit and vegetable program, or did not take part in pouring rights contracts that establish a beverage company as the sole-source vendor for beverages in the school. Less than one quarter of schools had a nutrition or health advisory council. Of the schools that had a council, 66% involved parents. Elementary schools were significantly more likely than secondary schools to not have pouring rights contracts (54% of elementary schools versus 31% of secondary schools; $P = .002$), with ~ 80% of high schools having these contracts. In 75% of high schools, the students were not permitted to leave the campus during their lunch hour.

Competitive foods were available in a high percentage of schools, although the availability of these foods varied significantly among elementary, middle, and high schools. For example, 83% of elementary schools and 18% of middle schools did not have vending machines, whereas vending machines were present in nearly all of the high schools. More than 40% of secondary schools allowed vending machines to be placed in the food service area. Approximately half of the schools restricted the sale of competitive foods and beverages through fundraising activities, and 86% of schools had no stores or snack bars. However, these restrictions were significantly less common in high schools than in elementary and middle schools.

Where vending machines were present, low-nutrient, energy-dense foods and beverages were nearly always present in some machines. For example, of the secondary schools that had vending, only 15% of schools had no access to machines containing low-nutrient, energy dense foods and beverages (20% and 9% of middle and high schools, respectively). With respect to a-la-carte sales, 21% of schools did not offer any a-la-carte items

TABLE 3 **Prevalence of SFEPs According to School Grade Levels**

Variable	*n*, Schools	All, % (SE)	Elementary, % (SE)	Middle, % (SE)	High, % (SE)	*P*[a]
Policies and practices of district or school						
Has school wellness policy	381	43.2 (3.9)	46.6 (5.2)	38.8 (5.6)	35.4 (5.9)	
Has nutrition or health advisory council	387	21.7 (3.5)	18.9 (3.9)	15.0 (3.7)[b]	37.4 (9.6)	
Provides nutrient content for USDA meals	390	60.3 (4.1)	61.1 (5.1)	61.9 (6.2)	55.7 (6.6)	
Has nutrition education in every grade	382	68.1 (3.5)	79.8 (3.9)	72.0 (5.1)[c]	26.3 (5.8)[d]	<.001
No pouring rights contract	395	45.3 (4.0)	53.7 (5.5)	40.7 (6.3)[b]	21.7 (5.1)[d]	<.01
No items offered from brand-name restaurants	395	71.8 (4.5)	69.6 (4.8)	72.3 (5.1)	78.6 (5.0)[e]	.14
Uses government fruit and vegetable program[f]	392	42.6 (4.9)	43.1 (5.0)	47.6 (6.1)	36.0 (6.6)	
Has nutrient requirements for food purchasing	392	54.4 (5.3)	52.5 (5.3)	57.8 (6.3)	57.6 (8.3)	
Availability of competitive foods and beverages						
No store or snack bars selling food	391	86.4 (2.3)	91.0 (2.8)[g]	85.9 (3.5)[b]	72.0 (5.5)[d]	<.01
No fundraising activities	381	55.5 (4.3)	62.1 (4.9)	50.1 (5.8)	39.1 (8.0)[e]	.04
No vending machines	389	55.2 (3.2)	82.6 (3.8)	17.8 (4.2)[b,d]	3.3 (2.3)[d,g]	<.001
Has vending but not in food service area	389	24.2 (3.1)	11.9 (3.5)	45.9 (5.6)[d]	42.6 (8.2)[d]	<.001
Characteristics of USDA lunches offered						
Whole and 2% milk not offered	394	33.0 (4.1)	32.9 (4.7)	32.1 (5.1)	34.2 (9.6)	
Fresh fruit or raw vegetables offered daily	394	50.2 (4.8)	46.9 (5.2)	56.3 (6.5)	55.3 (9.0)	
French fries not offered	394	23.3 (3.6)	26.8 (4.5)	16.3 (4.6)	18.7 (6.6)	.16
Dessert not offered	394	23.9 (3.3)	24.5 (4.0)	25.1 (4.9)	21.1 (4.9)	
Average meal has ≤30% of calories from fat	394	19.5 (3.1)	22.3 (4.0)	15.7 (4.2)	14.0 (4.4)	

[a] Data show the *P* value for overall χ^2 test assessing difference in percentages across elementary, middle, and high schools, shown only where the *P* value is <.20.
[b] The percentage was significantly different from high schools ($P < .05$).
[c] The percentage was significantly different from high schools ($P < .001$).
[d] The percentage was significantly different from elementary schools ($P < .001$).
[e] The percentage was significantly different from elementary schools ($P < .05$).
[f] School used the Department of Defense Fresh Fruit and Vegetable Program or state Farm to School Program.
[g] The point estimate may be statistically unreliable because of the small sample size or large coefficient of variation.

(or offered only skim or 1% milk as a la carte items). This percentage differed significantly across elementary, middle, and high schools, at 29%, 8%, and 7%, respectively ($P < .01$). Similar to vending, where a la carte items were offered, low-nutrient, energy-dense foods or beverages were nearly always among those available for purchase. Of the schools offering a la carte items, only 41% of elementary schools and 21% of secondary schools (14% and 28% of middle and high schools, respectively), were free of low-nutrient, energy-dense items.

In USDA school lunches, fresh fruits and vegetables were offered daily at half of schools. In one third of schools, the only type of milk offered was either skim or 1% milk. In 22% of elementary schools, the average lunch offered was low fat (≤30% of calories from fat), and in 27% of elementary schools, French fries were not offered at all during the target week. Approximately one fourth of schools did not offer dessert on any of the days during the target week.

There was a significant decrease in mean SFEP scores across elementary, middle, and high schools (Table 4), indicating that school food environments become less healthy as children move to higher grade levels. Schools not located near cities had a significantly lower mean SFEP summary score than schools in cities or suburbs. Schools with medium-size student enrollment had a significantly higher mean SFEP summary score than schools with small or large enrollment.

We did not find a significant relationship between the SFEP summary score and the percentage of students in the school who were certified for FRPL or the percentage of students in the school who were racial/ethnic minorities. This finding was true when we analyzed elementary, middle, and high schools separately. The relationship between the mean SFEP summary score and the percentage of students in the school who were racial/ethnic minorities approached statistical significance ($P = .06$). These findings about the association between the food environment, as measured by the mean SFEP summary score, and the race/ethnicity and income levels of students in the school were generally true when we examined the 17 individual items that comprise the SFEP summary score (Table 5). Three individual policies were significantly related to the race/ethnicity of students. Schools with a higher percentage of racial/ethnic minority youth were less likely to have a nutrition and health advisory council, but they were more likely to offer skim or 1% milk and more likely to offer lunches that were lower in fat. The 1 policy that was significantly related to the income of students was the daily lunch offering of fresh fruit and vegetables, which was significantly less common in schools with a higher percentage of students certified for FRPL.

DISCUSSION

Despite the recent legislative efforts in some states to improve school food environments, we found that competitive foods and beverages were still commonly available in US public schools in the spring of 2005, particularly in secondary schools. Vending machines and a la carte sales were common sources of competitive foods, and these sources often contained low-nutrient, energy-dense foods and beverages, such as sugar-sweet-

TABLE 4 **Association Between School Characteristics and SFEP Score**

Characteristic	Score (SE)	*P*[a]
School grade levels		
Elementary school	9.2 (0.3)	<.001[b]
Middle school	8.0 (0.2)	
High school	6.8 (0.2)	
Student enrollment[c]		
Small	7.8 (0.5)	.05[d]
Medium	9.2 (0.3)	
Large	8.5 (0.2)	
Percentage of racial/ethnic minorities		
Low (≤10% of students are minorities)	7.7 (0.5)	.06[e]
Medium (>10%–45% of students are minorities)	8.8 (0.3)	
High (>45% of students are minorities)	9.2 (0.2)	
Household income		
High (≤30% of students certified for FRPL)	8.8 (0.3)	.2[f]
Medium (>30%–50% of students certified for FRPL)	7.9 (0.5)	
Low (>50% of students certified for FRPL)	8.9 (0.2)	
Proximity to a city		
In a city	9.1 (0.3)	.01[g]
Suburb of city	9.0 (0.3)	
Not near a city	7.9 (0.4)	

[a] Data show the *P* value for ANOVA comparing means across all of the categories.
[b] The *P* value for comparison between elementary and middle schools is .001, elementary and high schools is <.0001, and middle and high schools is <.0001.
[c] Schools were placed in 1 of 3 groups (small, medium, or large) by using the following criteria for the number of students enrolled: elementary and middle schools (small: ≤400; medium: 401–600; or large: >600) and high schools (small: ≤450; medium: 451–1000; or large: >1000).
[d] The *P* value for comparison between small and medium is .03, between small and large is .23, and between medium and large is .05.
[e] The *P* value for comparison between low and medium is .06, between low and high is .01, and between medium and high is .29.
[f] The *P* values for all of the comparisons between any 2 levels of the variables are >.05.
[g] The *P* value for comparison between city and suburb is .87, between city and not near a city is .01, and between suburb and not near a city is .01.

ened soft drinks and candy. The majority of the SFEPs that we examined did not vary significantly by the percentage of school students who were racial/ethnic minorities or who were certified for FRPL. However, elementary schools had significantly healthier food environments and policies than did secondary schools.

Only a small number of studies have examined food environments and policies in nationally representative samples of US schools.[8,13–16,27,28] One of the largest studies to date is the School Health Policies and Programs Study (SHPPS), which collected data from a nationally representative sample of public and private schools in 2000 and 2006.[16,28] This study found a lower prevalence of vending machines, with 62% of middle schools and 86% of high schools having ≥1 vending machine, as compared with 82% and 97% of middle and high schools, respectively, in our study. In contrast, the SHPPS revealed a higher prevalence of school stores and snack bars, with 33% of middle schools and 50% of high schools having a store, canteen, or snack bar that sold food or beverages, as compared with 14% and 28% of middle and high schools, respectively, in our study. These differences could reflect methodologic differences between the 2 studies or actual changes between 2005 and 2006. Consistent with our findings, an analysis of the 2000 SHPPS data did not find that the percentage of schools with brand name fast foods or pouring rights varied with the percentage of students who were non-Hispanic white.[29]

The Monitoring the Future study is another nationally representative study that examined school food environments among middle and high school students during 2004–2005.[27] Consistent with our study, this study did not find differences by race/ethnicity or socioeconomic status in the percentage of students in schools with pouring rights contracts. This study did find differences by race/ethnicity in students' exposure to brand name fast foods, with Hispanic high school students having greater access than their black and white counterparts.

A study by the US General Accounting Office (GAO) assessed the availability of competitive foods in a nationally representative sample of 319 public schools in 2003–2004.[8] This study found that 75% of schools sold food and beverages a la carte, which was very close to our estimate (79%). The prevalence of having any vending machines was ~20% higher in the GAO study than in the present study; in particular, vending machines were less common among elementary schools (17% in the present study versus 46% in the GAO study). However, the GAO study had a low response rate (51%), whereas the district and school response rate for the SNDA-III was 83% and 95%, respectively.

Other studies have focused mainly on competitive foods and have not included schools across all grade levels.[13,15] A recent report from the Centers for Disease Control and Prevention, using data from their 2004 School Health Profiles from public secondary schools in 27 US states, reported on the availability of competitive foods,[13] whereas the National Center for Education Statistics reported on competitive foods from a nationally representative sample of 1198 public elementary schools in the spring of 2005.[15] These 2 studies, taken together, support our finding of a marked difference in the availability of competitive foods as children move to higher grade levels. Among middle schools and high schools, 90% sold snack foods or beverages through vending machines, school stores, canteens, or snack bars,[13] whereas only 23% of elementary schools had vending machines and 35% had snack bars or school stores.[15] By comparison, these percentages from the present study were 91%, 17%, and 9%, respectively. The study of School Health Profiles from secondary schools showed, as we did, that, where vending machines were allowed, low-nutrient, energy-dense foods or beverages were almost always available.[13]

We did not find a significant relationship between the SFEP summary score and the percentage of students in the school who were certified for FRPL or the percentage of students in the school who were racial/ethnic minorities. This finding was true when we analyzed elementary, middle, and high schools separately. The relationship between the mean SFEP summary score and the percentage of students in the school who were racial/ethnic minorities approached statistical significance ($P = .06$), with a trend toward higher (healthier) scores in

TABLE 5 **Percentage of Schools With SFEPs According to Household Income and Racial/Ethnic Composition of School Students**

Variable	Household Income				Percentage Minority			
	High % (SE)	Middle % (SE)	Low % (SE)	*P*[a]	Low % (SE)	Middle % (SE)	High % (SE)	*P*[a]
Policies and or practices of district or school								
Has school wellness policy	39.6 (6.3)	36.9 (7.4)	50.3 (5.8)		35.7 (7.4)	41.7 (6.1)	51.0 (6.2)	
Has nutrition or health advisory council	25.6 (5.4)	27.7 (8.7)	14.3 (3.8)	.15	29.2 (8.8)	25.7 (5.4)	11.1 (3.2)	.02
Provides nutrient content for USDA meals	57.2 (7.2)	69.8 (7.2)	56.4 (6.2)		48.7 (8.7)	67.5 (6.5)	62.7 (5.7)	
Has nutrition education in every grade	69.8 (5.7)	61.1 (7.4)	71.8 (4.9)		61.4 (8.0)	75.0 (4.6)	67.0 (5.4)	
No pouring rights contract	51.5 (7.0)	43.7 (7.1)	41.7 (5.9)		44.0 (6.8)	43.6 (7.0)	48.3 (6.4)	
No items offered from brand-name restaurants	65.9 (7.3)	71.6 (8.2)	76.4 (6.0)		79.2 (7.2)	59.4 (7.2)	77.1 (5.5)	.06
Uses government fruit and vegetable program	36.6 (7.2)	37.0 (8.8)	51.8 (7.0)		31.2 (8.7)	42.8 (7.1)	53.4 (7.3)	.19
Has nutrient requirements for food purchasing	45.8 (7.6)	48.5 (11.7)	65.8 (6.7)	.12	48.3 (12.1)	59.5 (7.3)	55.1 (7.3)	
Availability of competitive foods and beverages								
No store or snack bars selling food	85.0 (3.5)	87.7 (3.8)	86.6 (4.0)		87.7 (4.3)	84.0 (4.4)	87.8 (3.1)	
No fundraising activities	62.3 (6.0)	48.3 (9.2)	55.6 (5.6)		50.4 (9.8)	54.2 (6.6)	61.5 (5.7)	
No vending machines	49.6 (5.8)	52.9 (6.5)	61.4 (4.8)		47.4 (6.0)	54.8 (5.9)	62.6 (4.6)	.15
Has vending but not in food service area	25.7 (6.0)	25.4 (4.8)	22.1 (4.5)		22.7 (6.6)	27.5 (5.7)	22.2 (3.9)	
Characteristics of USDA lunches offered								
Whole and 2% milk not offered	34.3 (7.0)	36.6 (7.5)	29.0 (5.5)		18.9 (7.0)	35.9 (6.9)	43.5 (6.7)	.04
Fresh fruit or raw vegetables offered daily	61.5 (6.4)	52.7 (11.4)	39.4 (5.7)	.04	53.9 (11.7)	55.6 (6.6)	41.2 (6.1)	
French fries not offered	35.5 (6.9)	15.4 (5.1)	20.0 (4.5)	.05	22.8 (7.6)	26.3 (5.9)	20.8 (4.6)	
Dessert not offered	28.9 (6.1)	17.8 (6.0)	24.9 (4.9)		15.4 (5.4)	21.6 (5.2)	34.6 (5.8)	.08
Average meal has ≤30% of calories from fat	26.0 (5.0)	11.5 (4.4)	20.8 (4.8)	.08	7.8 (2.9)	23.1 (5.3)	27.1 (5.4)	.01

Schools were placed in 1 of 3 categories on the basis of the percentage of students in the school who were certified for FRPLs. The 3 categories were high (≤30% of students certified for FRPL), medium (30%–50% of students certified for FRPL), and low (>50% of students certified for FRPL). Schools were placed in 1 of 3 groups based on the percentage of students in the school who were part of any racial/ethnic minority groups (here defined as those who are not non-Hispanic white). The 3 categories were low (≤10% of students are from racial/ethnic minority groups), medium (10%– 45% of students are from racial/ethnic minority groups), and high (>45% of students are from racial/ethnic minority groups).

[a] The *P* value was for overall χ^2 test assessing difference in percentages and is shown only where the *P* value is <.20.

schools with a higher percentage of youths who were racial/ethnic minorities. With respect to individual environmental and policy characteristics, we did find that the daily offering of fresh fruit or vegetables in NSLP lunches was significantly less common in schools with a higher percentage of low-income students. This is consistent with research showing that children from lower socioeconomic families have lower fruit and vegetable intake[30–32] and supports the need for ongoing USDA efforts to provide fresh fruit and vegetables to schools, especially those with a higher percentage of low-income children.[33] In contrast, schools with the highest percentage of racial/ethnic minority youth were significantly more likely to offer only skim and 1% milk daily or to offer low-fat lunches.

A strength of this study is that it provides a more complete summary of SFEPs compared with previous studies. In addition to describing the competitive food environment, it describes school food purchasing policies for school meals, the presence of mandated school wellness policies, and the foods served in the NSLP. The survey data of this study from principals about vending machines were confirmed by checklist data completed during on-site observations in a subsample of schools. These on-site observations also included data on the availability of low-nutrient, energy-dense foods and beverages through both vending machines and a la carte cafeteria sales.

Along with these distinctive features, our study also had several limitations. The SFEP summary score assigned an equal weight to each of the items (with the exception of the 2 items assessing vending machine presence), but we knew of no evidence to establish which items were most strongly associated with student health or, specifically, their risk of obesity. Despite this limitation in the score, the relationships that we observed between the score and the student income and race/ethnicity measures were generally similar to what we found when we examined the individual items comprising the score. For some of the SFEP score items, we assumed that these policies or practices were established at the school level and not at the district level, because data were not available about level at which the policy was established. Similarly, several states have passed legislation to regulate school food environments,[9] and we cannot assess the level at which policies are established or how much autonomy schools have in their implementation. The variation that we observed by school grade levels on such variables as pouring rights contracts suggests that schools have some influence over how district policies are applied. Another limitation of the food environment measures was that our analysis did not investigate the hours during which vending machines were accessible to students. This information was collected from school staff, but more than a third of respondents were unable to provide this information, and this limited our ability to analyze these data.

Our selected school-level measure of household income may not have been associated with variation in SFEP, because the income measure classified schools according to the percentage of poor students (ie, certified for FRPL) and not by a measure that better distinguishes degrees of income or wealth. Moreover, socioeconomic status is a complex construct,[34,35] and income captures only 1 aspect of the social and economic resources avail-

able to students and parents in these communities. We may have observed variation in food environments and policies with a different measure of socioeconomic status, such as parental education.

In US public schools, there seems to be much room to improve the healthfulness of foods and beverages available to students during the school day, particularly in secondary schools. A recent report from the Institute of Medicine recommends that schools apply stricter nutritional standards to competitive foods and beverages.[1] The data in this study indicate that 2 sources of competitive foods and beverages, vending machines and a la carte cafeteria sales, were present in the great majority of US public secondary schools. Where these 2 sources were present, they were rarely free of low-nutrient, energy-dense items. Sixty percent of students who attend US schools are now offered fresh fruit or raw vegetables every day in their USDA school lunches. However, in the same cafeterias serving those USDA lunches, 79% of schools are also serving competitive foods and beverages, and 24% have vending machines.

We hypothesized that schools with a higher percentage of minority or socioeconomically disadvantaged youth would have less healthy school food environments, differences that might contribute to disparities in childhood obesity. We did not find evidence to support our hypothesis. However, as schools try to improve their food environments, particularly outside the NSLP, disparities in these environments could emerge if schools with more minority or socioeconomically disadvantaged youth are slower to adopt these improvements.

CONCLUSIONS

Parents, pediatricians, and other stakeholders have the opportunity to play an important role in changing social norms to promote healthy SFEPs. The areas identified in our school food environment summary score could help those working with school administrators to identify target areas for potential improvement in the school food environment. Furthermore, these findings can foster a discussion and debate about whether it is reasonable to make the food environments and policies of middle and high schools more like those of elementary schools by providing less choice and imposing greater restrictions on what foods and beverages older children can access during the school day.

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REFERENCES

1. Committee on Nutrition Standards for Foods in Schools. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*. Washington, DC: Institute of Medicine; 2007
2. Committee on Prevention of Obesity in Children and Youth. *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: Institute of Medicine; 2004
3. Gleason P, Suitor C. *Children's Diets in The Mid-1990s: Dietary Intake and Its Relationship With School Meal Participation*. Alexandria, VA: US Department of Agriculture Food and Nutrition Service, Office of Analysis Nutrition and Evaluation; 2001. CN-01-CD1
4. French SA, Jeffery RW, Story M, et al. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS Study. *Am J Public Health*. 2001;91(1):112–117
5. French SA, Story M, Fulkerson JA, Hannan P. An environmental intervention to promote lower-fat food choices in secondary schools: outcomes of the TACOS Study. *Am J Public Health*. 2004;94(9):1507–1512
6. Perry CL, Bishop DB, Taylor GL, et al. A randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. *Health Educ Behav*. 2004; 31(1):65–76
7. Kubik MY, Lytle LA, Story M. Schoolwide food practices are associated with body mass index in middle school students. *Arch Pediatr Adolesc Med*. 2005;159(12):1111–1114
8. US General Accounting Office. *School Meals Programs: Competitive Foods Are Widely Available and Generate Substantial Revenue for Schools*. Washington, DC: US General Accounting Office; 2005. GAO-05–563
9. Boehmer TK, Brownson RC, Haire-Joshu D, Dreisinger ML. Patterns of childhood obesity prevention legislation in the United States. *Prev Chronic Dis*. 2007;4(3):A56
10. Black J. Senate drops measure to greatly reduce sugar and fat in food at schools. *Washington Post*. December 15, 2007:A02
11. Hedley AA, Ogden CL, Johnson CL, Carroll MD, Curtin LR, Flegal KM. Prevalence of overweight and obesity among US children, adolescents, and adults, 1999–2002. *JAMA*. 2004; 291(23):2847–2850
12. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*. 2006;295(13):1549–1555
13. Centers for Disease Control and Prevention. Competitive foods and beverages available for purchase in secondary schools: selected sites, United States, 2004. *MMWR Morb Mortal Wkly Rep*. 2005;54(37):917–921
14. Greves HM, Rivara FP. Report card on school snack food policies among the United States' largest school districts in 2004–2005: room for improvement. *Int J Behav Nutr Phys Act*. 2006;3:1
15. Parsad B, Lewis L. *Calories In, Calories Out: Food and Exercise in Public Elementary Schools, 2005*. Washington, DC: US Department of Education, National Center for Education Statistics; 2006:NCES 2006–057
16. Wechsler H, Brener ND, Kuester S, Miller C. Food service and foods and beverages available at school: results from the School Health Policies and Programs Study 2000. *J Sch Health*. 2001; 71(7):313–324
17. US Department of Education NCfES. *Overview of Public Elementary and Secondary Students, Staff, Schools, School Districts, Revenues, and Expenditures: School Year 2004–05 and Fiscal Year 2004*. Washington, DC: US Department of Education; 2006
18. Wang Y, Beydoun MA. The obesity epidemic in the United States: gender, age, socioeconomic, racial/ethnic, and geographic characteristics—a systematic review and meta-regression analysis. *Epidemiol Rev*. 2007;29:6–28
19. Goodman E. The role of socioeconomic status gradients in

explaining differences in US adolescents' health. *Am J Public Health.* 1999;89(10):1522–1528
20. Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med.* 2002;22(1):23–29
21. Zenk SN, Schulz AJ, Israel BA, James SA, Bao S, Wilson ML. Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. *Am J Public Health.* 2005;95(4):660–667
22. Gordon A, Fox MK. *School Nutrition Dietary Assessment Study III: Summary of Findings*. Cambridge, MA: Mathematica Policy Research, Inc; 2007
23. Raper N, Perloff B, Ingwersen L, Steinfeldt L, Anand J. An overview of the USDA's dietary intake system. *J Food Consum Anal.* 2004;17(13–14):545–555
24. No Child Left Behind Act of 2001. Pub L. No. 107–110. 20 USC 6301 et seq. January 8, 2002
25. National Center for Education Statistics common core data Web site. Identification of rural locales. Available at: http://nces.ed.gov/ccd/rural_locales.asp. Accessed May 4, 2007
26. Life Sciences Research Office Federation of American Societies for Experimental Biology. *Third Report on Nutrition Monitoring in the United States*. Vol 1. Washington, DC: US Government Printing Office; 1995
27. Delva J, O'Malley PM, Johnston LD. Availability of more-healthy and less-healthy food choices in American schools: a national study of grade, racial/ethnic, and socioeconomic differences. *Am J Prev Med.* 2007;33(4 suppl):S226–S239
28. O'Toole TP, Anderson S, Miller C, Guthrie J. Nutrition services and foods and beverages available at school: results from the School Health Policies and Programs Study 2006. *J Sch Health.* 2007;77(8):500–521
29. Brener ND, Everett Jones S, Kann L, McManus T. Variation in school health policies and programs by demographic characteristics of US schools. *J Sch Health.* 2003;73(4):143–149
30. Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, Kahle LL. Fruit and vegetable intakes of children and adolescents in the United States. *Arch Pediatr Adolesc Med.* 1996;150(1):81–86
31. Lowry R, Kann L, Collins JL, Kolbe LJ. The effect of socioeconomic status on chronic disease risk behaviors among US adolescents. *JAMA.* 1996;276(10):792–797
32. Neumark-Sztainer D, Story M, Resnick MD, Blum RW. Correlates of inadequate fruit and vegetable consumption among adolescents. *Prev Med.* 1996;25(5):497–505
33. Buzby JC, Guthrie JF, Kantor LS. *Evaluation of the USDA Fruit and Vegetable Pilot Program: Report to Congress.* Washington, DC: Food and Nutrition Research Program, Food and Rural Economics Division, Economic Research Service, US Department of Agriculture; 2003:03–006
34. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research: one size does not fit all. *JAMA.* 2005;294(22):2879–2888
35. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health.* 1997;18:341–378